WHO VISITS NATIONAL PARKS? THE EFFECT OF CHANGING LOCAL DEMOGRAPHICS ON NATIONAL PARK VISITORSHIP

by
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1. Abstract

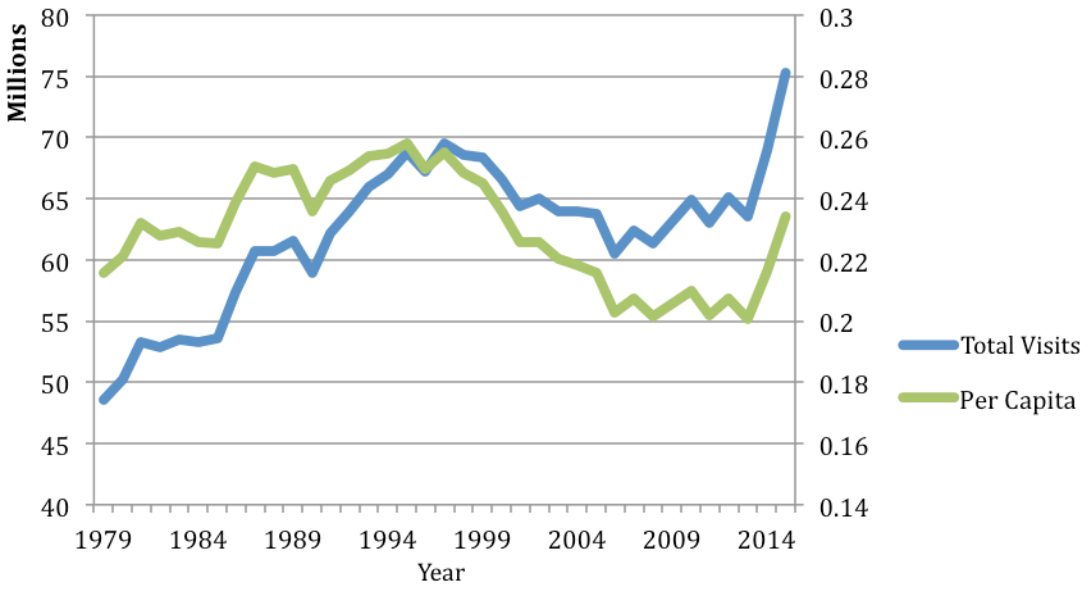
During a two-decade general decline in visits to U.S. national parks during the 1990s and 2000s, annual visits to one-third of national parks actually increased. Previous research shows that park attendance varies by race, ethnicity, age, income, and education. This paper examines whether shifting demographics in the regions surrounding each national park explain historical fluctuations in visits. A linear fixed-effects model is used to estimate whether changes to these demographic indicators in the 100 miles surrounding national parks impacted visitation. The study found that local demographics had a statistically significant effect on park visitation and explained nearly half of year-to-year fluctuations in visits within each park. The effect of a change in local population on park visits was far smaller for African-American and Hispanic populations than white populations, suggesting that the National Parks System will face further challenges as the U.S. continues to become more diverse.

2. Introduction

The total number of annual visitors to U.S. National Parks has experienced unprecedented fluctuations in recent decades. After steadily increasing since the beginning of the 20th century, annual visitors peaked at 69.4 million in 1997, dropped to 60.5 million in 2006, then shot up to 75.3 million in 2015. Measured as per capita visits, the decline is more significant and the recovery less dramatic: from 0.26 visits per capita in 1997 to 0.20 in 2006 and 2013, increasing to 0.23 in 2015 (Figure 1).

Figure 1

Total and Per Capita National Park Recreation Visits, 1979-2015



Source: U.S. National Park Service. "Annual Visitation by Park (1979-Last Calendar Year)." Accessed June 4, 2017. https://irma.nps.gov/Stats/Reports/National. World Bank. "Population, Total." Accessed July 5, 2017. http://data.worldbank.org

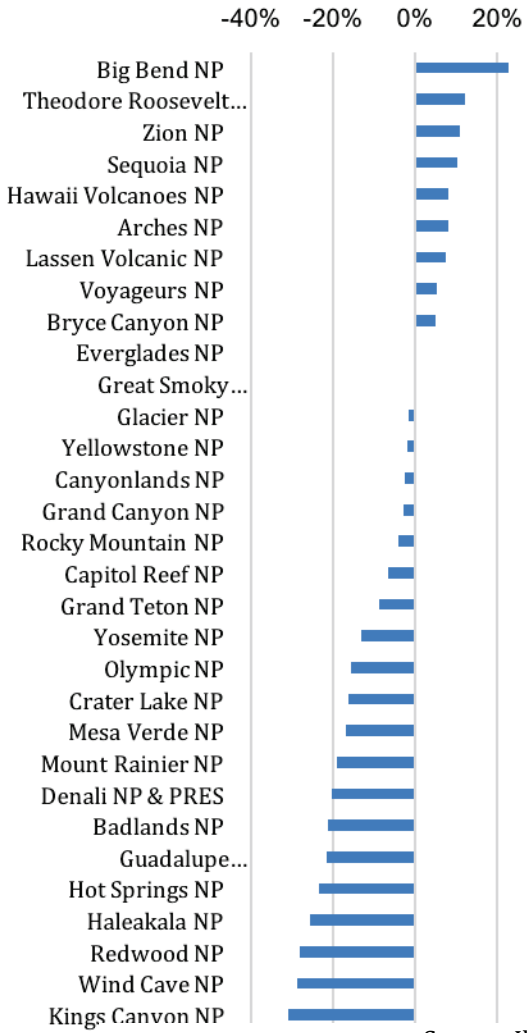
This decline in outdoor recreation has been seized upon as evidence of a significant and widespread shift in the American public's interest in the outdoors, raising concerns about the future of conservation and environmental protection efforts. Previous academic research has sought to explain declining park visits in terms of a shift in interest away from nature towards television, movies, and video games, or in terms of national economic changes and September 11th-related security concerns.

However, studies focusing only on national trends do not address why visits to many national parks increased as nationwide visits declined. From 1995 to 2008, as overall recreation visits to parks decreased by 10%, visits to one third of national

parks increased (Figure 2). That changes in visitation during this period varied so much by park suggests an explanation that accounts for changes local to each park.

Several large-scale demographic changes over the last several decades are likely to have had an effect on local park attendance. On one hand, the physical distribution of the U.S. population has changed, with more people living on the coasts and in the Southwest, and fewer in the Great Plains and Appalachia, affecting how many people are within driving distance of each national park. In addition, decades of national surveys and academic research suggest that park visitation rates vary by race, ethnicity, age, education, and income. The demographic makeup of the U.S. has significantly changed, becoming more racially and ethnically diverse, as well as older. The U.S. population has also become more educated, and wages have risen in certain regions but stagnated in others.

Figure 2
Change in Annual Recreation Visits, 1995-2008



Source: Ibid.

The goal of this study is to test whether demographic changes local to national parks can explain annual variation in recreation visits at each national park. Changes

in population local to the park are expected to have a positive relationship on park visits. Changes in demographic composition by race, ethnicity, age, education, and income in the area surrounding each park are expected to significantly affect visitation, and consistent with earlier studies on this subject, the effect of an increase in population on visitation is expected to be larger for white residents than for minority residents, larger for wealthier and more educated residents, and less for older residents. Lastly, changes in demographics local to a park are expected to be a stronger predictor of visitorship to that park than national demographic trends.

3. Literature Review and Theoretical Framework

3.1 Theories on Declining Visitorship

3.1.1 Media Consumption

One line of research of the decline of visitors to U.S. national parks in the 1990s and 2000s has explored the role of increased electronic media consumption. In 2006, Pergams and Zaradic found that a large increase in time spent consuming television, movies, the Internet, and video games was strongly correlated with national park visitation reduction between 1979 and 2003.[1] A later study by the same authors found similar declines in nature-based recreation during this time period in Japan and Spain, suggesting that the cause might not be an economic or cultural change specific to the U.S.[2] Together, these studies suggested that people were choosing to spend

[1] Pergams, Oliver R. W., and Patricia A. Zaradic. "Is Love of Nature in the US Becoming Love of Electronic Media? 16-Year Downtrend in National Park Visits Explained by Watching Movies, Playing Video Games, Internet Use, and Oil Prices." Journal of Environmental Management 80, no. 4 (September 2006): 387–93. doi:10.1016/j.jenvman.2006.02.001.

[2] Pergams, Oliver R. W., and Patricia A. Zaradic. "Evidence for a Fundamental and Pervasive Shift Away from Nature-Based Recreation." Proceedings of the National Academy of Sciences 105, no. 7 (February 19, 2008): 2295–2300. doi:10.1073/pnas.0709893105.

more time indoors consuming electronic media, a phenomenon they named "videophilia", rather than recreating outdoors on public land.

An extensive review of recent literature did not identify any studies testing the relationship between media consumption and park visitorship with data after 2003. This omission is glaring, since real and per capita national park visitation rose in the following decade at the same time electronic media consumption increased with the invention and widespread adoption of home broadband, smartphones, and social media.[3] With new technologies, electronic media consumption has the potential to enhance or encourage outdoor recreation, for example through sharing photographs of park visits on social media or using smartphones to access information about a park during a visit. Although beyond the scope of this study, the "videophilia" hypothesis should be reconsidered in light of new data and technologies.

3.1.2 Economic and Social Factors

Other research has found that national park visitation rates have been sensitive to more traditional economic factors. Rising gasoline prices and declining median incomes were found to have had significant negative effects on park visitation, as did the September 11th terrorist attacks[4] and economic recession.[5] Increases to park entrance fees introduced in the 1990s may have negatively affected

[3] Smith, Aaron. "Record Shares of Americans Have Smartphones, Home Broadband." Pew Research Center. Accessed July 7, 2017. http://www.pewresearch.org/fact-tank/2017/01/12/evolution-of-technology/.
[4] Stevens, Thomas H., Thomas A. More, and Marla Markowski-Lindsay. "Declining National Park Visitation: An Economic Analysis." Journal of Leisure Research 46, no. 2 (2014): 153–64.
[5] Poudyal, Neelam C., Bamadev Paudel, and Michael A. Tarrant. "A Time Series Analysis of the Impact of Recession on National Park Visitation in the United States." Tourism Management 35 (April 2013): 181–89. doi:10.1016/j.tourman.2012.07.001.

visitation,[6] although the effect was small, perhaps because such costs are a small proportion of total expenses for a trip that might include lodging, transport, and food.

3.1.3 Demographic Factors

Other research on park visitorship has focused on outdoor recreation participation among different demographic groups, and whether America's changing demographics can explain park visitation trends. National surveys on outdoor recreation habits have found significant differences in participation rates between different demographic groups. The U.S. government-commissioned National Survey on Recreation and the Environment (NSRE), taken from 1982 to 1983, found a positive relationship between the number of days spent doing outdoor activities per year with rising income and higher levels of education, and a negative relationship with greater age, and that white respondents spent nearly twice as many days recreating outdoors as black respondents.[7] A survey commissioned by the National Park Service, taken in 2000, found similar relationships between race, income, education, and age, on whether someone had visited a national park in the previous two years.[8] A 1987 review of studies of wilderness users found that those between the ages of 16 and 35 were over-represented, while those 55 and older were

[6] Schwartz, Zvi, and Li-Chun Lin. "The Impact of Fees on Visitation of National Parks." Tourism Management 27, no. 6 (December 2006): 1386–96. doi:10.1016/j.tourman.2005.12.015.
[7] 1982-1983 Nationwide Recreation Survey. U.S. Department of the Interior, National Park Service, 1986. https://www.srs.fs.usda.gov/trends/nsre-directory/survey-82.html.
[8] United States National Park Service. The National Park Service Comprehensive Survey of the American Public: Technical Report. Social Research Laboratory, Northern Arizona University, 2001.

underrepresented, and that income and education were positively associated with wilderness use.[9]

Explanations for racial and ethnic disparities in outdoor recreation participation can be divided into four broad, non-exclusive theories.[10] First, the marginality hypothesis posits that because racial and ethnic minorities tend to have less socioeconomic resources, they tend to have less time and money to devote to visiting national parks, resulting in lower visitation rates. Second, the subcultural hypothesis proposes that different races and ethnicities have different values and interests, with different preferences towards outdoor recreation. For example, African-American and Hispanic communities may have less positive associations with spending time in nature or traveling long distances than communities of European backgrounds, which could contribute to lower park visitation rates for these groups.[11] Third, the cultural assimilation theory suggests that minority groups over time will acquire preferences from the majority, and therefore that disparities in cultural preferences towards national parks will diminish over time. Lastly, the discrimination hypothesis proposes that direct or perceived discrimination at national parks or anxiety about such discrimination contributes to lower participation rates by minorities.

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[9] Roggenbuck, J. W., and A. E. Watson. "Wilderness Recreation Use: The Current Situation." General Technical Report - Southeastern Forest Experiment Service, USDA Forest Service, no. No. SE-52 (1989): 346–56.

[10] Floyd, Myron. "Race, Ethnicity and Use of the National Park System." Social Science Research Review 1, no. 2 (Spring/Summer 1999): 1–24.

[11] Carter, Perry L. "Coloured Places and Pigmented Holidays: Racialized Leisure Travel." Tourism Geographies 10, no. 3 (July 29, 2008): 265–84. doi:10.1080/14616680802236287.

3.2 National Demographics and Park Visitorship

Over the last half century, the U.S. population has become much older due to declining birth and death rates and more racially and ethnically diverse owing to increasing immigration. These trends are expected to continue, with the proportion of the population over age 65 expected to increase from 12.8% in 2009 to 20.2% in 2050, and the proportion of the population of Hispanic origin expected to rise from 15.1% in 2009 to 30.2% in 2050.[12]

Although little research has been conducted on whether past demographic changes have had an effect on park visitorship, several studies have combined park usage rates from national surveys with population projections to forecast future national outdoor participation rates. Such projections often predict a decline in future participation due to the expected increase in the proportion of the population that is older and non-white. A 1991 forecast of participation in outdoor activities based on age, race, and ethnicity expected declining rates through 2025 in all outdoor activities except birdwatching.[13] A probabilistic model that included age, ethnicity, race, income, and education forecast a 15% decline in per capita participation in wilderness recreation between 2002 and 2050.[14] Projections by the National Forest Service, when segmented by activity type and using NSRE data up to 2009, found that

[12] Shrestha, Laura B., and Elayne Heisler. "The Changing Demographic Profile of the United States." Congressional Research Service, March 31, 2011. https://fas.org/sgp/crs/misc/RL32701.pdf.
[13] Murdock, Steve H., Kenneth Backman, Md. Nazrul Hoque, and David Ellis. "The Implications of Change in Population Size and Composition on Future Participation in Outdoor Recreational Activities." Journal of Leisure Research 23, no. 3 (1991): 238–59.
[14] Bowker, J. Michael, D. Murphy, H. Ken Cordell, Donald B. K. English, J. C. Bergstrom, C. M. Starbuck, C. J. Betz, and G. T. ; Green. "Wilderness and Primitive Area Recreation Participation and Consumption: An Examination of Demographic and Spatial Factors." Journal of Agricultural and Applied Economics 38, no. 2 (August 2006): 317–26.

participation rates for certain activities (e.g. skiing, equestrian) were expected to increase, while others (e.g. hunting, backpacking) were expected to decline through 2060.[15]

3.3 Regional Demographics and Park Visitorship

Demographic changes at the regional level have taken place at a much faster pace than at the national level. Certain regions of the U.S. have been disproportionately affected by recent demographic change from immigration and migration. The top destinations for immigrants every year from 1971 to 2009 have been California, New York, Texas, Florida, Illinois, and New Jersey, with 62% of immigrants in 2009 moving to these states.[16] Southwestern states near the Mexican border have experienced a large increase in population: between 2000 and 2010, the population increased in Arizona by 25%, Nevada by 35%, Texas by 21%, and Utah by 24%, compared to a 10% increase nationwide.[17] Meanwhile, states in the Great Plains and Appalachia experienced very low population growth due to a negative net migration over the last several decades. Different age groups have also exhibited unique migration patterns, with people in their twenties and early thirties moving to metropolitan areas in the East, South, and intermountain West, while those in their

[15] Cordell, H. Ken. "Outdoor Recreation Trends and Futures: A Technical Document Supporting the Forest Service 2010 RPA Assessment." U.S. Department of Agriculture Forest Service, Southern Research Station, March 2012. https://www.srs.fs.usda.gov/pubs/gtr/gtr_srs150.pdf.
[16] Shrestha and Heisler.
[17] Franklin, Rachel S. "An Examination of the Geography of Population Composition and Change in the United States, 2000-2010: Insights from Geographical Indices and a Shift-Share Analysis." Population, Space and Place 20, no. 1 (January 2014): 18–36. doi:10.1002/psp.1744.

late-thirties and forties disproportionately moved to Florida, the Ozarks, and the Upper Great Lakes during the 1990s.[18]

Research on a relationship between local demographics and park visitorship is mixed, but suggests that most park visitors live in the same region as the park. Surveys of wilderness users reviewed in 1987 found that most resided in the same state as the wilderness area, although areas near other states or with a popular reputation tended to have more out-of-state visitors.[19] A logistic regression model predicting park visitation based on distance and demographic factors found that the distance from home to the nearest wilderness area had a significant negative effect on visitation, and that the mean distance from home was 76.7 miles.[20] Another model predicting park visitation in Texas found no significant relationship between the distance from a county to the closest national park and park visitation rates for that county.[21] However, Texas may be unique in that the largest cities are at least 300 miles from the nearest national parks.

Distance has often been cited in national surveys as a barrier to visiting national parks; a 2000 survey commissioned by the National Park Service found that distance was the most common barrier cited by respondents who had never visited a national park, and 51% of all respondents cited distance as a reason for not visiting more often. Distance was more commonly cited as a reason for not visiting by African-

[18] Johnson, Kenneth M., Paul R. Voss, Roger B. Hammer, Glenn V. Fuguitt, and Scott Mcniven. "Temporal and Spatial Variation in Age-Specific Net Migration in the United States." Demography 42, no. 4 (November 1, 2005): 791–812. doi:10.1353/dem.2005.0033.
[19] Roggenbruck and Watson.
[20] Bowker, Murphy, Cordell, English, Bergstrom, Starbuck, Betz, and Green.
[21] Lee, Kyung Hee, and Michael A. Schuett. "Exploring Spatial Variations in the Relationships between Residents' Recreation Demand and Associated Factors: A Case Study in Texas." Applied Geography 53 (September 2014): 213–22. doi:10.1016/j.apgeog.2014.06.018.

American respondents than white respondents.[22] Another study found that African Americans, Asian Americans, and Hispanics tend to live farther from national parks than whites, and that this distance explains some of the disparities in visitation rates.[23]

3.4 The Gap in Existing Research

An extensive review of the literature found no recent study evaluating the effect of local demographic changes on fluctuations of park visitorship. Given the decades of surveys showing a relationship between demographics and park visitation, the changes in regional demographics, and the evidence that park visitors tend to live near parks, a relationship between local demographics and park visits should be expected. Parks in areas where populations have had increases in groups who are most likely to visit parks should see an increase in visitors, while those parks near populations that have changed in composition so that they are underrepresented in parks should see a decline in visitors.

4. Data and Methods

4.1 Methodology

This study uses a fixed effects model to isolate the causes of changes in park visits over time, as opposed to differences in visits between parks. The model estimates a separate intercept for each national park, accounting for the impact on

[22] Solop, Frederic I., K. Hagen, and David Ostergren. "Ethnic and Racial Diversity of National Park System Visitors and Non-Visitors." National Parks Service Social Science Program, Comprehensive Survey of the Amercian Public, 2003, 1–13.
[23] Weber, Joe, and Selima Sultana. "Why Do So Few Minority People Visit National Parks? Visitation and the Accessibility of 'America's Best Idea.'" Annals of the Association of American Geographers 103, no. 3 (May 1, 2013): 437–64. doi:10.1080/00045608.2012.689240.

visits of unobserved effects specific to each park, which include many of the characteristics that help make certain parks more popular tourist destinations: natural beauty, availability of activities, name recognition, and proximity to airports and other tourist attractions. Such attributes may help explain much of a park's popularity, but tend not to vary much from year to year, so do not explain why park visits fluctuated so much from 1980 to 2015. A fixed effects model controls for the randomness of such fixed effects and isolates the effect of variables that change over time. The model used in this study is:

$$Annual\ Visitors_{it} = fn(National\ Population_t + X_{1,it} + \ldots + X_{p,it} + \alpha_i)$$

This model is a function of national park i and time t. *National Population* is the population of the United States and $\alpha_1, \ldots, \alpha_n$ are estimated intercepts for each national park. X_1 ,..., X_p are local demographic statistics, measured as sums of demographic figures of all census-designated counties within 100 miles of a park boundary. Five different models were tested, one without any local variable *X*, three with different local demographic variables for population, race and ethnicity, and income and education, and a fifth with *National Population* excluded.

4.2 Data

Data measuring the dependent variable, annual recreation visits to each park, are from the National Park Service. The National Park Service defines a recreation visit as the entry of a person into the park, and excludes non-recreation visits by persons who work or live on the park.[24] Although 59 national parks are currently

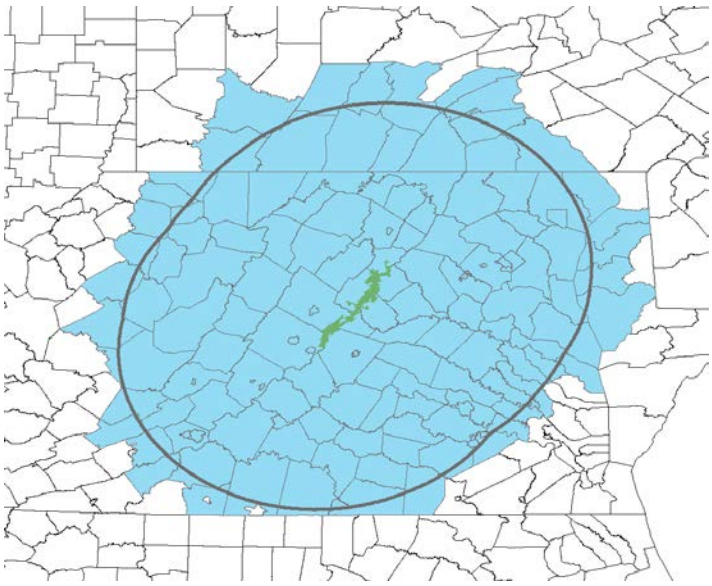
[24] U.S. National Park Service. "2016 NPS Statistical Abstract." Accessed July 24, 2017. https://irma.nps.gov/Stats/Reports/AbstractsAndForecasts.

operated by the National Park Service, only 36 had complete data from 1980 to 2015 and were included in this study due to changes in how some parks calculate annual visits and the creation of new parks after 1980.

The independent variables were drawn from data on population, age, education, income, ethnicity, and race in the decennial census and the American Community Survey (ACS), both collected by the U.S. Census Bureau. The decennial census and ACS are collected differently; the former being a once-a-decade constitutionally mandated population count of everyone in the U.S. while the latter is a nationwide rolling survey that is being continually revised. Due to the smaller sample size of the ACS, county estimates are only available across 5-year averages. Between the decennial census and the ACS, complete national and county-level data are available for the years 1980, 1990, and 2000, and the 5-year averages of 2006 to 2010 and 2011 to 2015.

County demographic data for each independent variable were measured as counts of persons or households for the given demographic category. For race and ethnicity, this was the number of persons identifying as that race or ethnicity; for education, the number of persons age 25 and older with at least a B.A. degree or higher; and for income, the number of households exceeding a given income. Because county-level income data is summarized into income ranges that are not exactly comparable over time after adjusting for inflation, a floating threshold was used of the income level closest to $55,000 per year in 2015-adjusted dollars. As a result, the *high income* variable represents the number of households, that, depending on the year, had annual incomes greater than as low as $50,000 or as high as $61,000.

Figure 3
Counties within 100 Miles of Shenandoah NP



For each park, local demographic variables were calculated as the sum of the demographic statistics of all counties within a 100-mile radius from the park boundary. This is shown in Figure 3, with the park in green and the counties within 100 miles in blue. National park boundaries were taken from the National Park Service and census boundaries from the U.S. Census Bureau. Park and county boundaries were projected into the US National Atlas Equal Area coordinate system before determining if they were within 100 miles of one another. As can be seen in Figure 3, any intersection, however small, between the 100-mile park buffer and a county boundary were included. Statistical summaries were made using a Python script, and geospatial transformations and comparisons were made with the GDAL and OGR libraries. Regression analysis was conducted in R using the plm package.

5. Results

5.1 Summary Statistics

To assess temporal patterns in the demographic data and possible biases introduced by the subset of parks chosen, statistics are presented in Table 1 for 1980 and the 5-year average of 2011 to 2015, calculated nationwide, within 100 miles of all national parks, and within 100 miles of the 36 national parks in this study.

Table 1 National and Local Demographic Trends	**1980**	**2011-15**
% of Total Population Living…		
Within 100 Miles of any National Park	35.1%	41.2%
Within 100 Miles of any National Park in Study	19.6%	24.2%
% of Population that Identifies as white…		
Nationwide	83.1%	73.6%
Within 100 Miles of any National Park	82.7%	72.2%
Within 100 Miles of any National Park in Study	83.7%	73.4%
% of Population that Identifies as black…		
Nationwide	11.7%	12.6%
Within 100 Miles of any National Park	9.8%	10.8%
Within 100 Miles of any National Park in Study	9.7%	10.7%
% of Population that Identifies as Asian or Pacific Islander…		
Nationwide	1.5%	5.3%
Within 100 Miles of any National Park	2.2%	6.7%
Within 100 Miles of any National Park in Study	1.9%	6.4%
% of Population that Identifies as Hispanic…		
Nationwide	6.4%	17.1%
Within 100 Miles of any National Park	8.3%	21.1%
Within 100 Miles of any National Park in Study	6.3%	19.8%
% of Population Age 65 or Older…		
Nationwide	11.3%	14.1%
Within 100 Miles of any National Park	10.9%	14.1%
Within 100 Miles of any National Park in Study	10.9%	14.3%
% of Population with B.A. or Higher…		
Nationwide	16.2%	29.8%
Within 100 Miles of any National Park	16.8%	30.0%
Within 100 Miles of any National Park in Study	17.2%	30.4%
% of Households with high income…		
Nationwide	55.5%	53.4%
Within 100 Miles of any National Park	56.5%	53.9%
Within 100 Miles of any National Park in Study	55.6%	54.6%

The demographic composition of residents living near national parks is slightly different than nationally. Compared to national-level demographic compositions, African Americans make up approximately 2% less, Asian or Pacific Islander residents make up approximately 1% more, and Hispanic residents make up

approximately 2% more of the "local" park population. This difference can be attributed at least in part to geography, given that national parks are concentrated in the western half of the U.S. and that this region tends to have proportionally fewer black residents and more Asian or Pacific Islander and Hispanic residents. Residents near parks also tend to have slightly more education, with approximately 0.5% more residents having a B.A. or higher than the national average. The differences in demographic composition reflects what groups have more or less physical access to parks, but would not be expected to affect the model.

Changes to demographic variables between 1980 and 2011 to 2015 are consistent with expected changes discussed in the literature review: the national population and residents near national parks have become more racially and ethnically diverse, older, and better educated. Nationally and local to national parks, about 10% less of the population identified as white, 1% more as black, 4% more as Asian or Pacific Islander, and 12% more as Hispanic. At the same time, the proportion of people age 65 and older increased by around 3%. The largest change to a demographic category was in education, with approximately 13% more people over the age of 25 nationally and local to a national park holding a B.A. degree or higher in the 2011 to 2015 period than in 1980. Of note, the percentage of the national population living within 100 miles of a national park increased by about 6% between 1980 and 2011 to 2015.

There were very few differences in trends between the subset of national parks chosen for this study and the park system as a whole. While the proportion of the population of each demographic sometimes differed, the change in composition

between 1980 and 2011 to 2015 was nearly identical for all demographics. Although not included in Table 1, the change in recreation visits between 1980 and 2011 to 2015 for the subset of parks in this study, an increase of 35.4%, was similar to the change for national parks overall, an increase by 33.6%. The similarity in trends over time suggests that biases introduced by the choice of parks should be controlled for by the fixed effect, and that the results of the regression should be externally valid to the rest of the parks.

5.2 Regression Analysis Results

The results for the five fixed effects regression models for the 36 national parks included in the study are shown in Table 2. The first model, in column 1, includes only park fixed effects and a variable for the national population. The effect of national population on park recreation visits is statistically significant to the .001 level, and equivalent to about 4 annual visits to each park per increase in the national population by 1,000 persons. This effect explains an average of 17% of annual variation in visits within each park, as shown by the within-R^2value of 0.17.

The second model, in column 2, adds the total population within 100 miles from each park as a variable. According to this estimate, an increase of the local population by 1,000 persons increases visitation by an average of 100 visits, while an increase of the national population by 1,000 persons increases visitation by an average of 2 visits, or approximately half of the previous effect. Both coefficients are significant to the .01 level. This model improves model fit, increasing the within-R^2 from .17 to .21. This model is consistent with the hypothesis, as local population has a positive effect on park visits.

Table 2
Regression Analysis of National and Local Demographic Effects on National Park Visitorship

Dependent variable: annual recreation visitors per park					
Regressor	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**
National Population	0.004*** (0.001)	0.002** (0.001)	0.001 (0.001)	0.002** (0.001)	
Within 100 miles of Park					
Population (total)		0.10** (0.04)			
Population (white)			0.81*** (0.14)	1.01*** (0.16)	1.07*** (0.16)
Population (black)			-1.3*** (0.33)	0.63 (0.48)	0.08 (0.45)
Population (Hispanic)			-0.54*** (0.13)	-1.02*** (0.15)	-0.97*** (0.15)
Population (Asian, Pacific Islander)			0.65** (0.24)	2.66*** (0.46)	2.35*** (0.46)
Households, high income				1.62* (0.71)	1.79* (0.73)
Population (B.A. or higher)				-2.45*** (0.43)	-2.21*** (-.43)
Park fixed effects	yes	yes	yes	yes	yes
N	180	180	180	180	180
R^2 $(within)$	0.17	0.21	0.36	0.49	0.46

These regressions were estimated using annual recreation visits for the 36 national parks with complete data and decennial census and 5-year American Community Survey estimates for 1980, 1990, 2000, 2006-2010 and 2011-2015. Individual coefficients are statistically significant at the *.05 level, **.01 level, or ***0.001 level

To test whether the effect of local population differs when accounting for race and ethnicity, the total local population measure from the second model was replaced by four local race and ethnicity totals, used in the third, fourth, and fifth models in columns 3, 4, and 5. The third model, which uses only total national population and the local population race and ethnicity measures, substantially increased fit compared to the second model, increasing the within-R^2 from .21 to .36. The coefficients for white local residents are much higher than for black and Hispanic

residents, consistent with the hypothesis. The negative coefficient for Hispanic residents should not be directly interpreted, since ethnicity and race are different measurements. In the census data, Hispanic Americans most frequently also identify as white, so these coefficients should be considered in tandem. However, the negative coefficients for black residents is difficult to interpret and may point to an issue with omitted variable bias.

To help address omitted variables and test the hypothesized positive relationship between education, income, and park visitorship, variables for local measures of income and education were added to the fourth and fifth models. The addition of these two variables caused some change in the race and ethnicity coefficients, with the estimates for white and Asian or Pacific Islander residents increasing, for Hispanic residents decreasing, and for African-American residents to become no longer significant. Income was found to be positive and significant to the .05 level, corresponding to 1,600 additional park visits for every additional 1,000 high income households. Contrary to the hypothesis, the estimate for education was negative, corresponding to 2,450 fewer park visits per 1,000 residents with a B.A. degree or higher, significant to the .001 level. The addition of these two models substantially improved within-R^2, from .36 to .49. A variable for the number of residents older than age 65 was also considered for this model, but was excluded after it was found to not be statistically significant or have an effect on model performance.

Finally, the fifth model removes the national population variable from the fourth model. This results in a slightly lower within-R^2, from .49 to .46, with all significant coefficients remaining almost unchanged. This shows that most of the

explanatory power of the fourth model comes from the local population variables, and that the addition of national population only explains an additional 3% of annual visitation change within each park. This supports the hypothesis that local demographic trends have had a stronger effect on visitorship than national trends.

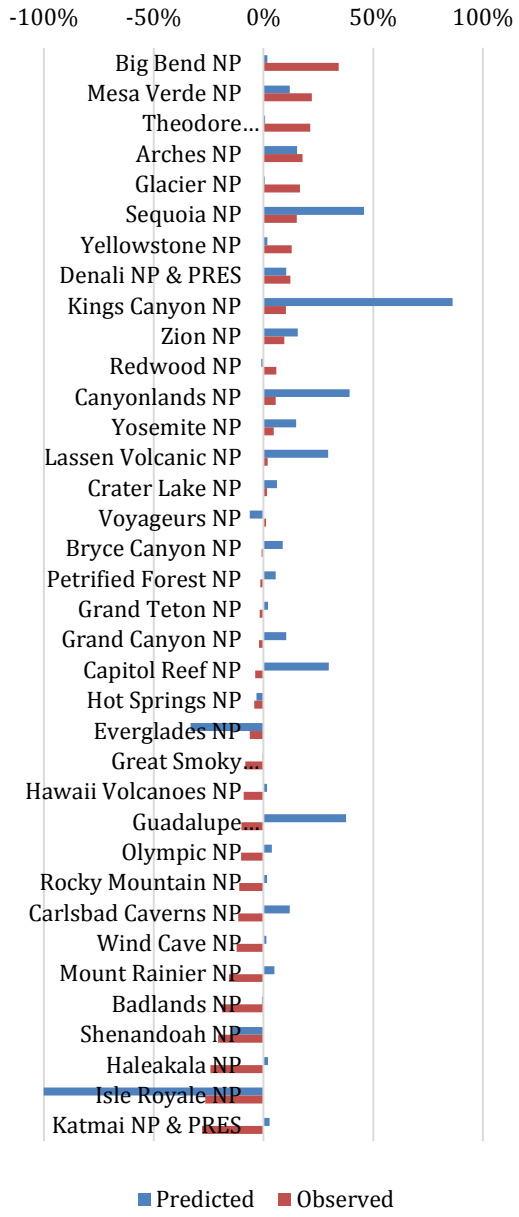
The fourth and fifth models suffer from multicollinearity due to a strong correlation between *population (white)* and *income*, with a Pearson correlation coefficient of 0.98, and between *income* and *education*, with a correlation coefficient of 0.97. The effect of this imperfect multicollinearity is that the estimated coefficients for these variables have considerably more sampling variance. While an additional model without *income* was explored and led to a small decline of the within-$R^2$and a small increase in the coefficients for *education* and *white*, all three variables were included since they each show significant relationships between the variables and park visits.

5.3 Discussion

These models show that annual visits to national parks are more strongly affected by local demographic changes than national population trends. Model 2 shows that the effect of increasing the local population by one is about 44 times stronger than of increasing the national population by one. Model 5, using only local demographic variables, better predicts fluctuations in park visits than model 1, which uses only national population, as indicated by the higher within-R^2 of 0.46 for the

local model, compared to 0.17 for the national model. An illustrative example of the difference in performance can be seen by comparing the observed and predicted change in park visits between 2000 and the average of 2006 to 2010, during which visitation declined at 20 of the 36 national parks in this study, as shown in Figure 4.

Figure 4
Predicted and Observed Change in Visits, 2000 to 2006-10 Avg.



While model 1 predicted increased visitations at all parks due to an 8% increase in national population during this period, the local demographic model correctly predicted declining visits at 6 of those 20 parks and that park visit growth would fall below national population growth for 22 of 26 parks.

The regression results also confirm earlier research showing disparities in park visitation based on race and ethnicity. Even when controlling for income and education, changes in the number of African-American and Hispanic residents were associated with far fewer park visits than for changes in the number of white or Asian and Pacific Islander residents. Including race, ethnicity, income, and education as

variables explained considerably more of the annual variations in park visitorship, as evidenced by the increase in within-R^2 from 0.21 to 0.49 from models 2 to 4.

A surprising finding from the regression results was that the number of local residents with a B.A. degree or higher had an inverse relationship with park visits. This finding seemingly conflicts with earlier research in the literature that shows that higher education is positively associated with having recently visited a national park. Perhaps residents with more education tend to visit national parks further than 100 miles from their county of residence, diminishing a local effect. More educated residents may be more aware of distant national parks and perceive greater benefit to visiting them. More education has an inverse relationship with family size, so the costs of longer distance travel (e.g. air transport, hotels) might be on average lower for higher educated residents.[25]

6. Conclusion

In this paper, national park visits are studied in terms of changing national and local demographics. Previous research in the literature found that park visitors are more likely to live near the park, and that visitation rates differ based on race, ethnicity, education, and income. Large fluctuations in park visits between 1980 and 2015 coincided with significant demographic changes, including increases in the population in some regions and an older, better educated, and more racially and ethnically diverse population.

[25] Pew Research Center. "Childlessness Falls, Family Size Grows Among Highly Educated Women." Washington, D.C., May 2015.

This study used county-level census data to determine how demographic changes within 100 miles of each park affected the number of park visits. Increases in the local population were expected to be positively associated with park visits, but, consistent with literature on this topic, the effect of an increase in white residents was expected to be higher than the effect of an increase in minority residents. Local demographics were expected to have more predictive power than national population.

Five fixed-effects regression models were used to test the hypotheses and found results that were mostly consistent with them. Increases to the population within 100 miles of a park increased visits by a statistically significant level of 1 annual visit per 10 residents. Race and ethnicity was a significant factor, and the effect of an increase in the number of white residents, at 8 to 10 visits per 10 residents, was much higher than the effect of increases in black or Hispanic residents. Increases in the number of higher-income households within 100 miles was also associated with a large and significant increase of park visits. The effect of changing local demographics on park visitorship was found to be much stronger than the effect of changes to the national population, and including national population in the model improved model performance only by a small amount.

The regression models returned some results that were inconsistent with the hypothesis. The number of residents age 65 and older did not have a significant effect on park visits and was not included in the models used in this paper, even though this variable was expected to show that such residents had a positive but lower effect than the general population. The model also showed that the number of residents within

100 miles of a park with a B.A. degree or higher was negatively associated with park visits, even though this demographic group has been repeatedly shown in previous research to visit national parks at a higher rate than the rest of the population.

A limitation to this study is that it estimates the effect of demographic change on park visits as fixed over time. While the model shows a large disparity in the effect on visits between white and minority residents between 1980 and 2015, it does not address whether this gap widened, closed, or remained constant over that period. While the cultural assimilation theory suggests that this gap should close over time, other theories explaining lower rates of park visits among minorities might not expect such a change. Unless this gap closes, the National Park Service will face a greater challenge to remain relevant as the U.S. population continues to grow more racially and ethnically diverse.

This study identifies a new way to forecast outdoor recreation demand using demographics. While previous studies have used national population forecasts to predict future park demand, this study demonstrates that local demographics have been more closely related to park visitorship. A model that uses population forecasts for the region surrounding each park should more accurately predict future park demand than a model that only uses national trends.

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8. Curriculum Vitae

Max Mealy was born in Davis, California in July 1987. He is currently an analyst with the Department of Defense. He previously worked as a research assistant at the Washington Institute for Near East Studies. He received his B.A. in International Studies from Johns Hopkins University in 2009, with a focus on the Middle East.